PROCEEDINGS OF FIRE WORKING GROUP SOCIETY OF AMERICAN FORESTERS

National Convention
Albuquerque, New Mexico Oct. 4, 1977

COMPILED BY RICHARD J. BARNEY

FIRE IN MULTIPLE USE MANAGEMENT PROGRAM

SOCIETY OF AMERICAN FORESTERS 1900

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PREFACE

A technical session on fire and land management planning was held by the Fire Working Group of the Society of American Foresters at the national meeting in Albuquerque, New Mexico, October 4, 1977. The purpose of this technical session was to bring together landowners, planners, and managers, as well as fire management personnel, to consider the effects of fire on the productivity of the resources we manage. It was hoped that, by such a session, individuals involved in land management planning and action could discuss a common problem heretofore not covered in such a context.

This session was a continuing attempt to maintain and develop the relevance of fire to other management activities. It was to provide the fire managers, as well as others, a current perspective and knowledge that a high quality, professional management of our natural resources could continue. This session was not all inclusive. However, by exposing the issues to a fire manager/planner/landowner audience, we hoped to clarify and provide alternatives for future communication and development.

Planning today is, perhaps, one of the most important activities of most federal land management agencies. With the changing posture of fire management, it is important that fire management be integrated into the planning process. This session was a continuing attempt to improve the fire integration process into the planning and management activities. Through such sessions and future sessions of this type, the fire working group is moving to improve and maintain the technical input and the professional competency of the products that evolve.

The papers presented in these proceedings are being published under one cover to provide improved distribution and access of information.

RICHARD J. BARNEY
Program Chairman

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RESEARCH SUMMARY

A compilation of papers presented at the Society of American Foresters, Fire Working Group technical session held in Albuquerque, New Mexico, October 2-6, 1977. The keynote address by Dr. M. Rupert Cutler, Assistant Secretary of Agriculture established the session's perspective on Fire Management and Land Management. Subsequent papers treated information needed by the land manager: how fire-related activities could be adapted to support land management activities; using simulation as a tool; and legislation affecting forest practices involving fire.

FIRE MANAGEMENT AND LAND MANAGEMENT

PUTTING THEM INTO PERSPECTIVE

M. Rupert Cutler

Assistant Secretary of Agriculture for

Conservation, Research and Education

Thank you for inviting me to participate with you in this Fire Working Group Technical session. It is appropriate that the Fire Working group discuss the relationship of fire to resource management and land management planning. The topics to be discussed today are certainly timely and deserve your attention. I feel it is significant that your working group is trying to involve landowners, managers and planners.

Fire was a front page news story this summer. The severe fire situation demonstrated quite vividly the negative impact of fire. This fire season again pointed out that man is still unable to master wildfire under severe conditions. It also points out that we must consider fire in our management activities. Some of these fires were influenced by man's past and present management activities -- and many of them will drastically change man's future management actions.

HISTORICAL PERSPECTIVE

In the late 1800's, fire control grew out of a need to protect resources from destruction. As fire control evolved, we developed some very effective fire fighting forces. Many of the time-honored principles and practices of fire control are as appropriate now as the day they were conceived. However, with changes in our information base, in sociological and political requirements, and in natural resource management objectives, it is now generally agreed that fire should be considered in its widest context.

In addition, man has been studying land use as it relates to agriculture for centuries and land use concerns have emphasized the relationship of fire to land management planning. Land use and land use planning have generated ever-increasing concern and interest since the environmental movement began in the early 60's. The National Environmental Policy Act of 1969, with its direction to Federal land agencies, added a new direction to the issue. Most recently the National Forest Management Act of 1976; the Federal Land Policy and Management Act of 1976, also know as the BLM Organic Act; as well as the Resources Planning Act of 1974; added more direction on Federal lands. In the State and private sector, there is also a growing concern and interest in land use planning.

FIRE-RESOURCE RELATIONSHIPS

Fire by itself is neither friend nor foe. It becomes "good" or "bad," only as it relates to man's value system. If you are a wildlife manager, and fire burns an area and the result is increased sprouting of browse species important to the animals you are dealing with, then fire is "good." If, however, timber management is your goal and that area was covered by a stand of 15- to 20-year old reproduction destined for harvest in 50 to 75 years, then fire is "bad." The total benefits and damages to all resources must be considered in assessing the net effect of fire.

Fire is used to convert less desirable vegetative cover types to cover types with more desirable species composition. Fire is also used to maintain ecosystems at certain stages of succession. Many other examples can be given to show both "good" and "bad" effects of fire. Again, let me point out that fire is only "good" or "bad" when man's value system is considered.

What I am getting at is the heart of this session today: fire, both good and bad, or the lack of fire, affects the production of wildland goods and services. Fire can detract from or enhance natural resource objectives. Fire can do either or both, depending upon vegetative composition, the physiographic situation, climate, fire behavior and the desired management objectives. Therefore, fire

must be considered as a resource modifier.

FIRE MANAGEMENT AND RESOURCE MANAGEMENT

Let me discuss fire management and its role in total resource management. Fire management, is a support or service function. Dr. Richard Barney our program chairman, in an article in the Journal of Forestry, defines fire management as, ". . .the integrating of fire-related biological, ecological, physical, and technological information into land management to meet desired objectives."

Fire management is the protection from fire and the use of fire in meeting defined land management goals and objectives. Fire prevention, fire control and fire use are the basic implementing activities. All economic and ecological implications must be considered. The major justification for public or private fire management should be based on the land manager's need to reach his objectives.

Fire must also be considered in the initial stages of resource management planning, as the objectives are being established. Fire should be considered in determining whether or not the objectives is realisitic and attainable. The management objectives must also be assessed in terms of their short- and long-range effects on the fire situation within the management area. Would intensive logging creat a fuel problem? Would logging increase the probability of fire? Would the increased fuel load intensify a fire, causing effects different than those required to meet the management objectives? Fire considerations must be reviewed following implementation or simulation of the management actions initiated to meet management objectives.

Fire can exert a strong influence on management options. We must be able to predict consequences or various fire management activities. activities. This requires a knowledge of preburn conditions, the particular kinds of fire involved, and the response of the ecosystem in time. Predicting the kinds of fires that will result requires understanding the variability of fuels on the ground, the probabilities of fire weather and the probabilities of a source of ignition. This is no small task and mades the fire manager's role much more complex. He must provide special expertise in fire ecology, fire suppression, fire use, fire prevention, fuels management and economics to assist the land manager in meeting his goals and objectives.

FIRE MANAGEMENT AND LAND MANAGEMENT PLANNING

There must be a link between land management planning and fire management planning. Land management planning is not complete without the consideration of fire. This does not mean that fire has to be a major factor in every plan, but it should be considered. On the other hand, fire could be very important in protecting, modifying or perpetuating the ecosystem. We must also assess the potential effect of planned management actions on the future fire situation. This must all be done on an interdisciplinary basis. Without interdisciplinary consideration, we haven't done our jobs as professional managers.

From the Federal forestry side of the ledger, there are legal requirements for interdiciplinary, multifunctional planning. I believe that fire considerations are definitely part of that interdiciplinary need. Regardless of whether the land is public or private, input is needed from the fire management specialist. He must assess the feasibility and the possibility of protecting a certain resource land base -- and protection is necessary both before and after a management activity. He must assess and indicate where fire can be used. He must help the other resource specialists focus on using fire to attain maximum production of a specific resource, such as timber, range or wildlife, while still protecting the environment.

Totally integrated land management plannning is beginning. It is here that we can determine the kinds of activities that ought to occur on a specific area. Fire planning must provide the necessary or indicated protection for the resources and must be commensurate with the values involved. Fire protection and use must support various management strategies so that the intended management goals and objectives can be reached.

SUMMARY

My challenge to each of you, landowners, managers, planners, is this -- consider fire as a resource modifier. Then, and only then, will fire assure a more realistic, more defensible, and more desirable perspective in land management planning and resource management strategies. This is the role that we must play if totally integrated land management planning is to be realized.

THE INFORMATION ABOUT FIRE NEEDED

BY THE LAND MANAGEMENT PLANNER

William N. Lyon

State Fire Management Officer, Bureau

of Land Management, Billings, Montana

Land use planning has truly reached a high plateau in this country. Planning is firmly entrenched and here to stay.

With the population increase and therefore increased resource demands, our resource producing land base is shrinking. We must strive for maximum production on the remaining land. To meet this challenge, planning is essential.

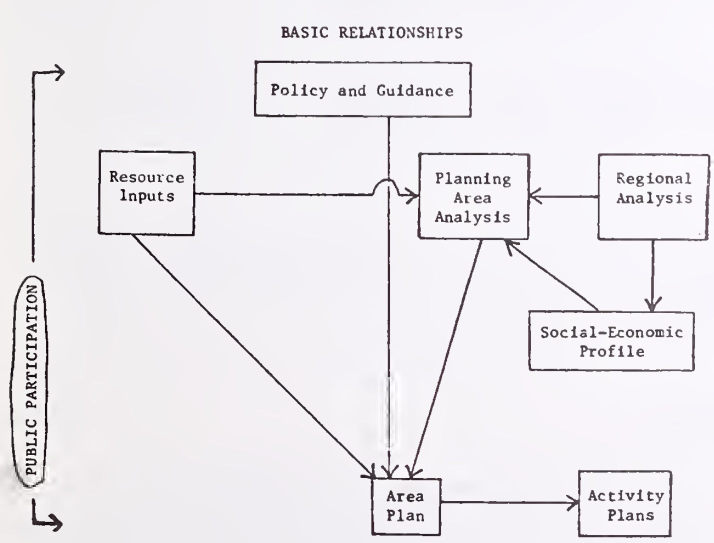
WHAT IS PLANNING?

"Planning is essentially the allocation and balancing of resource potentials with resource demands within social, political, biological, physical, economic and legislative constraints." (Barney & Egging 1977)

WHO DOES PLANNING?

Essentially everyone is involved in the planning process. Some more directly then others but somewhere along the line everyone contributes in some manner.

Most Planning Systems Have Similar Inputs
Planning System



ALL PLANNING FOLLOWS A SIMILAR FLOW

General Planning Flow

a - Set objectives
b - Identify issues
c - Gather information
d - Develop Alternatives
e - Selection - decision
f - Feedback and final (adjusted) decision
g - Individual activity plans developed

What is a Planner?

A planner is a sink for multifunctional information. Each resource function furnishes the planner with data which must be correlated and integrated into a management plan for a specific planning area.

For the purpose of this talk I am going to assume the role of a land planner. I will attempt to discuss some of the types of information which must be acquired and questions which must be raised for fire management to become truly integrated into the total planning process. In the time frame I cannot attempt to be specific on all the information needs. Perhaps I can stimulate a few ideas and raise a few questions.

Fire planning information must be fed into the system at all levels of the planning process. The resource personnel, fire specialist and planners must communicate with each other throughout the planning process. It is not a matter of the planner, as shown on the view graph, asking the fire specialist various questions about the effects of fire on each resource. Fire input data must flow with each resource plan and be considered throughout the entire process. The information must flow as now shown on the view graph.

I will now touch on some planning philosophies concerning fire:

1. Fire behavior can affect the way resources and funds are allocated to reach management objectives. Fire is a factor in production. Fire affects resources in several ways. The most obvious is the loss or modification of the initial resource. This is the effect that we hear the most about. Most people take notice of this initial short-term effect. The planner must consider not only the initial loss but the long-term effect in the area.

The resource damage potential depends upon the resource value and risk of fire. This criteria applies to resources in place and values and risks following planned resource actions.

Example

High value land -- high fire risk

vs

Low value land -- low fire risk

Perhaps in the low value-low risk area the fire effect of a planned action is negligible. Fire is considered and then dismissed. However, in the high value-high risk area a planned action may well change the whole effect of fire. From a funding standpoint the cost of fire presuppression and suppression actions may make the planned resource action prohibitive. If we are willing to accept losses we need to define the costs associated with these losses.

Fire may have an impact on the allocation of resources:

Example

A management plan calls for timber harvesting. This may be completely compatible with the other proposed resource actions. However, from a fire standpoint the amount of slash created is beyond the acceptable limit. Fire personnel can no longer protect the area within acceptable protection standards. The cost of presuppression and suppression may well be prohibitive. Fire can quickly wipe out or drastically change the intent of resource plans. At the same time fire may not have any effect. The main thing is, as planners, we need to know what the effect will be.

Therefore, fire management must enter into the early phases of the planning process, not only as it affects resources in place but also its effect on the allocated-planned resource action.

2. Political Acceptability.

There is a political acceptability factor involved in fire. Not only from wildfire but prescribed fire.

People generally cannot accept the unattractiveness of burned over areas. Whenever we plan prescribed burns we begin to feel the "outside" pressure.

Large wildfires cause a considerable amount of outside public pressure.

A. Perhaps a classic example occurred in Grand Teton National Park a few years ago. Following a management plan, a wildfire was allowed to burn. The supposed resource loss and smoke problems created a political beehive in the town of Jackson, Wyoming, and eventually nationally.

B. This last fire season a fire burned through Pattee Canyon near Missoula, Montana. Several homes were destroyed. This has created a social-political problem that will be around for a long time.

The political aspect created by fire must be considered in planning.

3. Short Term - Long Term.

Fire has a short-term and a long-term effect. Immediately after a fire it looks completely devastating. However, by the next year the burn area has improved considerably. At the same time the long-term effect may be the real problem. Planners must know what the short and long-term effects will be.

4. On Site - Off Site.

Fire may have an effect off-site as well as on-site. Smoke, drift of particulates, etc., may cause serious problems downwind from a burn.

Also, a burn in a certain area may create an "ice cream" area for wild or domestic animals. The invasion of above normal numbers of animals into the area may well create problems in adjacent areas.

Example

An area was prescribed burned. Nearby an area had recently been planted with Ponderosa Pine. Following the burn there was a marked increase of browse species. The deer and elk began to congregate in the burn area. As a result the new seedlings in the

adjacent area were either trampled or snipped off.

Planners must be made aware of these on site - off site interactions.

5. Safety

Safety is another aspect which must be considered. This is particularly true with the present urban-forest interface. People are building extensively in the "wilds." This is creating a problem which planners cannot ignore.

Example

A small tract sale in Arizona on the upper 1/3 of a mountain. Beautiful scenery -- back-to-nature type living. However, there is only one road and the fuels below the development are explosive. To add to this, forest product sales in lower country are creating slash and increasing the problem. Costs of prevention, presuppression and suppression have increased dramatically. This increased cost is directly tied to the safety of people.

Again, the on site - off site, long term - short term interaction of planning actions and fire -- planning with tunnel vision.

Safety must be considered in our planning.

One way to ensure that these problems are considered is to gather fire data on a probability basis. Not only from the existing resource standpoint but from each planned action as well.

The information resolution depends upon the level of planning. A broad base may be fine for upper level planning but must be specific for activity planning.

Planners need to know several things:

-The probable fire occurrence, numbers, location, time and cause

-The probable weather

-The probable fire size and intensities

-The probable effects of fire on various resources

-External impacts of access, recreation, logging, etc., both short and long term - on site and off site

-Effects of planned actions on suppression

-Effects of planned actions on fire costs

-Effects on probable consequences

Each activity must consider fire. The consequences of all planned actions must be determined. This is the first step. However, we still need to examine the overall interaction of all activities on a planning area. Independently they may be of no consequence, collectively they may be a disaster.

We need to know what alternatives the fire specialist can offer to help achieve management objectives. We also need to know and analyze the effect and cost of these alternatives. We need to know the effect of the alternatives on probable consequences in terms of resource production.

Planning is never complete, it is dynamic and must remain flexible to change. There are no stock answers but we must ask questions. We must challenge the fire specialist to furnish the needed information. We must create an awareness of fire as a modifier of production, either good or bad.

Awareness can only come through the interaction and interplay of fire, resource and planning personnel.

As John McGuire said in a speech in Missoula: "Fire managers must constantly ensure that fire is considered an equal component in forest ecology - along with soil, air, water, land, and life forms. Much of the progress that has been made in fire management will be cancelled out if fire is allowed to become an ecological island separated from the broad body of land use planning."

HOW FIRE-RELATED ACTIVITIES CAN BE TAILORED TO MEET RESOURCE MANAGEMENT OBJECTIVES

Clinton B. Phillips

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INTRODUCTION

Some of you may be like I am: a thick-skinned, hard-of-hearing traditionalist. For many years we fire fighters, fire managers, and resource managers have been bombarded, lambasted and harangued about the need to integrate fire and fire management into plans for managing wildland resources. The two previous speakers have again enunciated what we should be doing. Perhaps it is time we turned up our hearing aids and heeded the call for action.

How do we go about tailoring systems of fire management to meet the objectives of resource management? The answer is simple: It's not easy! But difficult tasks have never deterred us foresters, so let us accept this present challenge.

Before we can proceed to develop a plan of fire management for any given planning unit, we need to do at least four things:

1. Establish objectives for managing the resources.
2. Determine the effects of fire and fire management on the resources and on the objectives for managing them.
3. Determine the effects of various activities of resource management on different strategies of fire management.
4. Develop a procedure for fully integrating a plan of fire management into a multifunctional Grand Plan of Resource Management.

Let us take a broad view of each of these four tasks.

ESTABLISH OBJECTIVES FOR MANAGING RESOURCES

Probably few of us here today are in the position of actually establishing objectives of resource management. Generally that task is left to the Grand High Moguls and, at least in relation to government-owned lands, to the general public. It is right here, however, in the initial stages of planning a system of resource management, that we fire managers and resource managers must sit around the same table and hammer out a common understanding about the role of fire in the forest.

Fire can be either a scourge or a blessing to man and his resources, depending on how it is managed (Mutch 1972). Uncontrolled, fire can have highly dramatic and modifying effects on wildland resources. Under control, however, fire can be used to serve the objectives of the resources manager. And, because it is a natural element, fire must be used so that its dramatic effects also serve nature (Vogl 1974).

These two principles--the use of fire to serve both man and nature--need not be in conflict. Before they can be applied to the objectives for resource management, however, the net effects of fire upon resources must be determined.

EFFECTS OF FIRE AND FIRE MANAGEMENT UPON RESOURCES

Wildland ecosystems are extremely complex, and the effects of fire and fire management on those ecosystems are equally complex (Noste and Davis 1975). The effects of fire are a function of many things, including at least the following:

- . . the intensity, rate of spread, location, and size of given fires;
- . . the frequency of fires in any one location;
- . . susceptibility of individual resources to different intensities, sizes and frequencies of fires.

Despite its sudden and dramatic impacts, fire is usually selective. It affects individual resources in different ways: sometimes damaging, sometimes beneficial. It is the total range of effects, which vary according to the characteristics of individual fires and resources, that we are interested in.

Many effects of fire are not yet well understood, which complicates our task of integrating

fire into resource management. More and more, however, the relationships between fire and the production of resources are being established through research and field observations. A rather thorough summary of these relationships was made recently by the Society of American Foresters' Prescribed Burning Task Force (Martin et al 1977). Where the effects of fire on resources are not known, research still has a job to do.

To the degree that we can determine the net effects of fire on resources, we must distinguish between those fires which help to achieve the objectives of resource management and those which are counter-productive to the objectives or which may pose a threat to man and his environment (Barrows 1974). In other words, we need to distinguish between "wildfires" and "prescribed fires." You may prefer to call these, respectively, "unwanted fires" or "wanted fires," or any of several dozen other terms that seem to be used among us fire managers these days.

Where fire is determined to play a necessary and enhancing role, then it should be included in the plan for fire management. Certain lightning-caused fires might be allowed to spread freely under prescription. Or, as a substitute practice, fires might be deliberately ignited, also under prescription.

Many lightning-caused or man-caused wildfires are not wanted simply because their net effects may be contrary to the objectives of resource management or are threatening to human life and property. These fires must continue to be prevented or suppressed! Jim Agee (1974), an ecologist with the National Park Service, has said:

> "Some natural category areas protected from fire for many years have high fuel accumulations, which, if ignited, would result in an unnaturally intense fire. These areas must be protected from fire until fuel has been manually removed or prescriptions for burning have been developed."

If the decision is made to suppress unwanted lightning-caused fires, then some alternative practice must be provided that will resolve at least partially the conflict between man and nature. Prescribed fire should be the first choice, but only it is is determined to be cost effective and consistent with the objectives of resource management.

Now let's look at the effects of resource management on fire management.

EFFECTS OF RESOURCE MANAGEMENT ON FIRE MANAGEMENT

Each function of resource management, including fire management, must take a look at what impacts all the other functional plans might have on theirs. The plan for forest silviculture, for example, may call for thinning of young-growth trees with no specific provision for disposing of the fire-hazardous slash; such a plan would impact importantly on the plan for fire management. The plan for reforestation may call for valuable investments of both dollars and time; without adequate provision for protecting the young trees, the investments may disappear in a scintillating flash through the wizardry of wildfire (Wilson 1977).

This interplay among the many functions that serve resource management is a very difficult game to play. It requires maximum patience, coordination, understanding, and compromise.

Having done our homework, let's try to pull all our data and information together into a plan of fuel management.

A SUGGESTED PROCEDURE FOR DEVELOPING A PLAN OF FIRE MANAGEMENT

Figure 1 is a procedural model that could be used to integrate fire management into broad plans of resource management. Each step in the model actually has a complex sub-system of its own. Let's take a look at each of these steps without getting into too much detail concerning the sub-systems.

The purpose of Step 1 is to establish objectives for a plan of resource management. Since fire plays a role in virtually every wildland ecosystem, it must be considered in this first stage of planning. One of the best guidelines to use for this purpose is the U.S. Forest Service's booklet, "Fire Management Considerations for Land Use Planning" (Anonymous 1974).

The purpose of Step 2 is to assess the current fire situation for the management unit with which we are concerned:

1. History of fires and their effects on the resources being managed.
2. Sources of fire risk.
3. Expected fire behavior - dependent on fuels, weather and topography.
4. Worst probable fire situations.
5. System of fire management and protection provided at present.

These data and bits of information are used in Step 3, where the effects of fire on

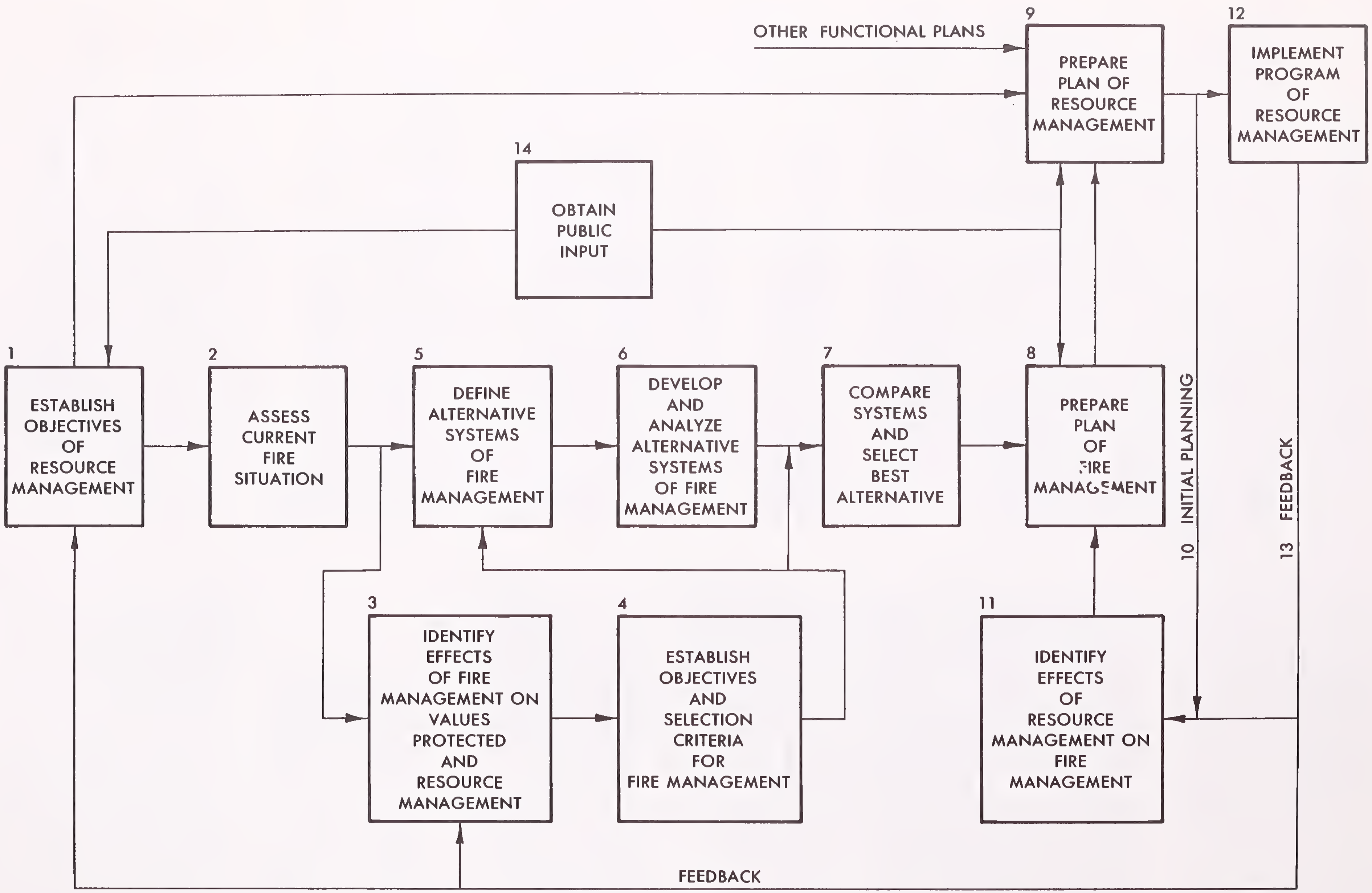

FIGURE 1. MODEL FOR INTEGRATING FIRE MANAGEMENT INTO RESOURCE MANAGEMENT.

resources are assessed, and in Step 5, where concepts are defined for planning alternative systems of fire management.

The purpose of Step 3 in the model is to identify or predict the net effects of fire and fire management on resource values and on the objectives of resource management. The net effects lead us to the definition of "values protected," i.e., that value of each resource which could be damaged or destroyed by the highest intensity of fire likely to occur within the planning unit (Noste and Davis 1975). The measure of "values protected" provides one of the more important elements for planning a system of fire management.

The purpose of Step 4 is to establish the objectives of fire management which will help achieve the objectives of resource management. Then, based upon these objectives, criteria are selected against which alternative systems of fire management will be compared in Step 7 to select the "best" system.

The objectives will tell us what it is we intend to achieve within a specified time period. The objectives are independent of the means of accomplishing them, and, at this stage of planning, they are also independent of the cost. They might take on forms something like the following:

> Allow each lightning-caused fire to burn freely so long as it is not threatening to spread beyond the bounds of the planning unit, and is not threatening human life or property.
>
> Suppress all wildfires as quickly as possible within the Brown's Ravine planning unit.

The selection criteria are established for the purpose of achieving the objectives. They enable the alternative systems of fire management developed in Step 6 to be compared for the purpose of identifying how well each alternative satisfies the objectives. Therefore, at least one selection criterion must be established for each objective. For example, an objective might be to burn stands of predominately ponderosa pine at least once every 10 years. For that objective, a selection criterion might be to select the system of fire management which would minimize ecological damage to the habitat of the Three-toed Hairy-chested Salamander; or which would minimize smoke over the community of Brown's Ravine; or which would maximize compatibility with cooperators.

If Step 4 is performed with care and insight, it should result in a thoroughly satisfactory system of fire management.

The purpose of Step 5 is to define alternative systems of fire management which will satisfy both the current fire situation and the objectives established in Step 4. The systems defined in this step will be further developed and analyzed in Step 6.

At least three alternatives should be defined, and preferably more:

1. The current system
2. The baseline system which is an extension of the current system
3. One or more additional systems which may be major departures from the current system.

Each alternative is described in narrative form with regard to general fire protection philosophy; prevention; detection; suppression; fuel management including the use of prescribed fire; interagency relationships; fire laws, regulations and codes; and support functions.

Each system is then compared to the objectives to assure that the objectives are met. The current system may or may not meet all objectives, but the baseline system and all other alternative systems must meet all objectives for all time periods.

The baseline system is basically the same program of fire management as the current system but with modifications to personnel, equipment, and facilities needed to meet both the current fire situation and the objectives established for the new system. One modification, for example, might be to increase the response on fire engines from three to five fire fighters.

The additional alternatives should incorporate as many new or different ways as possible of providing a system of fire management. By challenging tradition, much better and more cost-effective ways of fire management may be found for meeting the objectives of resource management. DESCON is an example of such an alternative (Jay 1976). Another alternative might be to shift emphasis from suppression to prevention by establishing more "greenbelts" to separate wildlands from urban environments.

The purpose of Step 6 is to develop further the alternative systems of fire management defined in Step 5 and to analyze them relative to a set of critical factors.

The further development of the alternatives involves identifying the organizational functions and the resources needed to perform the functions. Let us examine just one example: prevention. Sub-functions of fire prevention

might include education, law enforcement and engineering. Tasks to accomplish these subfunctions would include such things as inspections, investigations of fires, and analysis of data. The tasks would be further translated into numbers and types of personnel, equipment, facilities and materials needed to carry out the function of fire prevention.

Each alternative system of fire management would then be analyzed in terms of cost, benefit, legislative acceptance, political acceptance, ecological consequences, and other critical factors. Several powerful mathematical and modeling techniques have been developed in recent years for making analyses of these kinds.[1/] FOCUS (Fire Operational Characteristics Using Simulation) is one modeling technique that is being used operationally by several federal and state agencies to compare suppression alternatives against a given set of data (Phoenix 1976).

The purpose of Step 7 is to compare the alternative systems of fire management and to select the best alternative. The alternatives are ranked in relation to the critical factors of analysis used in Step 6: Cost, benefit, etc. They are also ranked in relation to the selection criteria developed in Step 4. Again, any one of several analytical techniques can be used in making the rankings.

The "best" alternative system of fire management is the one with the greatest total of weighted rankings. If we have used care and thought in establishing our selection criteria, priorities, and weightings of various values, and if we have used the best available information in comparing the alternatives relative to the various factors of analysis, then we should have confidence in our final selection.

The purpose of Step 8 is to develop further the best system of fire management selected in Step 7. The task in this step is to fill in the details of the plan so that it can be fully integrated into the plan being prepared for resource management. The plan should not be static for any period longer than one year and preferably less. It must be a continuous, dynamic, evolving plan intended to meet constant changes in (1) the needs for fire management, (2) the people's expectations and willingness to pay and (3) the technical capabilities of fire management (Phillips 1976).

1/ R. Benjamin. 1977. Policy analysis factors. Lecture given at the interagency course on advance fire management, Marana, Ariz.

Using principles of master planning, the plan of fire management might note who or what agency is to perform specific functions in what particular manner, and by what period of time in order to best accomplish objectives of both fire management and resource management. Not all functions need be performed by the responsible fire management agency. For a number of reasons--cost-effectiveness, expertise, the desirability of having a broad base of participation--it might be best that some functions be performed by other public or private agencies.

By now we should have a well-conceived plan of fire management, nicely packaged, and ready for presentation to the Grand High Moguls of Resource Management. Let us move onward with heads held high!

The purpose of Step 9 is to prepare a plan of resource management which uses the techniques of systems analysis to bring together a whole series of subsidiary plans, including a plan of fire management. Hopefully, we have done a good job of interfacing and coordinating our planning with other functions having inputs to resource management. But not until all the various functional plans are meshed into one Grand Plan of Resource Management can we accomplish the feedback shown in Steps 10 and 11 in our model.

Finally, there is a plan of fire management--which is good only for the moment, since changes are already occurring out there in the real world which will require changes in our plan of fire management. Step 13 is another feedback which recognizes this continual change and provides for it.

In keeping with this convention's theme of "Forests for People," the purpose of Step 14 is to insure that the public is given the opportunity to hear and comment upon the plans of the agencies that serve them. To paraphrase the Scottish poet Robert Burns, "The best-laid plans of mice and bureaucracies often go astray if the ordinary citizen doesn't understand or agree with them." You can select from your own local experiences to illustrate that observation.

CONSTRAINTS TO FIRE MANAGEMENT

Unfortunately, there are some important constraints to integrating fire management into resource management (Moore 1974). Here are just a few of them: Inadequate knowledge about fire management; the need to convert present knowledge into improved operational guidelines; the need for more training in the professional and technical aspects of using prescribed fire;

changing social values and patterns of land ownership; the fact that most state fire protection agencies have no legal authority to apply prescribed fire to privately owned land; liability for damages incurred by adjacent landowners as the result of escaped fires; the fact that a fixed-level budget may prevent fire managers from meeting stated objectives and enable them only to plan for the best allocation of available funds and resources; a lack of agreement among fire managers on terminology; and the fact that few universities and colleges include much fire management in their professional forestry courses.

CONCLUSION

Despite these and other constraints, good things are happening nationwide that should permit us to move ahead more swiftly in the planning of systems of fire management and fire protection. Among them are: (1) the Fire in Multiple-Use Management Project at the Northern Forest Fire Laboratory; (2) the Fire Management Planning and Economics Project at the Riverside Forest Fire Laboratory; (3) the Interagency Fire Planning Working Team of the National Wildfire Coordinating Working Group; and (4) the Interagency Course in Advanced Fire Management.

Hopefully, these new developments and this technical session will help to bring us closer together in realizing both the need and the way for integrating fire management into plans for resource management. I invite you to join me--one of the long-time traditionalists--in a quest for more imaginative and more effective ways of protecting and enhancing wildland resources through fire management. Let us stride forward with confidence!

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Simulation--A Thinking Tool

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United States Forest Service

Today, natural resource managers and scientists are required to evaluate and even anticipate the effects that management practices for a single resource will have on the production or use of all other natural resources. For example, a successful prescribed fire will accomplish the management objective for thinning and maintaining the desired stand age-structure. However, it is difficult to quantitatively evaluate the effects of the fire on wildlife habitat structure, forage and browse production, water yield, erosion, and recreation. After a fire, how long will it be before production of the other resources is restored or stabilized? If the fire were prescribed for a different time in the year, would the effects be the same? What would be the effects of a fire with a different intensity? Are some of the effects on the other natural resources in the ecosystem dependent on how long ago the same area was burned? If the same area were burned again 10 years from now, what would be the stage of plant and animal succession? Questions such as these and many more must be the concern of the forest manager. With so many factors, conditions, interrelationships, and variables involved in judging the effects of fire on a specific ecosystem, it is extremely difficult to be sure "all bases are covered."

Today, as in the past, judging the effects of a fire on other resources in the ecosystem was done through the experience of the manager. Experience takes time, is often confined to particular forest and climatic types, and is usually non-transferable--either to different forests or foresters! Collectively, the experience of managers and the results of research in the western United States probably represent the answers to 80% or 90% of the questions we need answers to. Why we do not have these answers when we need them is due to many reasons--ignorance, fragmental data, incomplete studies, (seemingly) unrelated studies, unpublished reports, thousands of individual studies that have not been summarized or synthesized, time--to name a few. Usually, such an unorganized state of our knowledge leaves us with little usefulness.

Can our knowledge of fire effects be organized to be more useful? The systems approach is a procedure worth considering. It is nothing more than the systematic organization of knowledge that explicitly recognizes the interrelations that are important for us to know for our purposes. Depending on our needs, a systems approach may result in economies of knowledge like a taxonomic key of tree species. A systems approach to a more dynamic problem may result in a computer program for projecting timber volume and growth for an all-age stand. Such "information rich" results of a systems approach are called models. Models represent the important details of the real world. They are much simpler than the real world and exclude many details we choose to omit or ignore.

The two examples we have mentioned, the taxonomic key and the computer program for predicting timber volume and growth, represent two basically different kinds of models. The taxonomic key is an example of a static model, and the volume-growth computer program is an example of a dynamic model.

The taxonomic key is a model of the essential features of tree species that are necessary to distinguish between similar trees. The economy of knowledge comes from reducing all the possible characteristics of the trees to a smaller number of important features that will consistently differentiate a given species from all the rest of the trees in the key. The taxonomic key is a static model because, once developed, the interrelationships in the key do not change. A topographic relief model of a watershed is another example of a static model.

The computer program for projecting future growth and volume of a timber stand is an example of a dynamic model. Dynamic models incorporate the mechanisms of how changes occur in the system, i.e., growth and volume of trees in different age (size) classes and the continuously changing volume in the different age classes. With dynamic models, we are able to "see the system in motion." Examples of other dynamic models include hydrologic models, wildlife population models, and photosynthesis models.

A model airplane is a common example used to illustrate the difference between static and dynamic models. If the purpose of modeling an airplane is to display a miniature on our desk, the model is static. If the purpose is to build a model to fly by remote control, we must include an engine and mechanisms to accomplish maneuvers, i.e., flaps, elevators, rudders, and a remote-control radio.

Some objects or phenomena (like the airplane example) can be modeled using mechanical or electronic relations. Others, because of their complexity, must be modeled by using mathematical or logical relations. In these cases, it is necessary to be able to write equations or logical sequences that simulate the behavior in response to changes we wish to impose or assume.

MANAGEMENT-ORIENTED SIMULATION MODELS

The wildland manager is faced with the problem of simultaneously managing a multiple resource base. The public manager is directed by law to manage for the multiple use and sustained yield of these resources (the Multiple Use-Sustained Yield Act, PL 86-517). In managing a land area, no resource or use can be isolated. Any management action, even when directed at one resource, is going to have an effect on the other resources of the area and the possible uses of those resources.

A logging operation started in any forest will affect not only the timber resource, but also the water, forage, and wildlife resources. This interaction can be illustrated as in Fig. 1 (Egging 1977a). For this reason the overall area with all its resources must be viewed as a whole in making any management decisions on a proposed activity.

Recognizing that man's activities impact the interrelationships of the ecosystem components, Congress passed the National

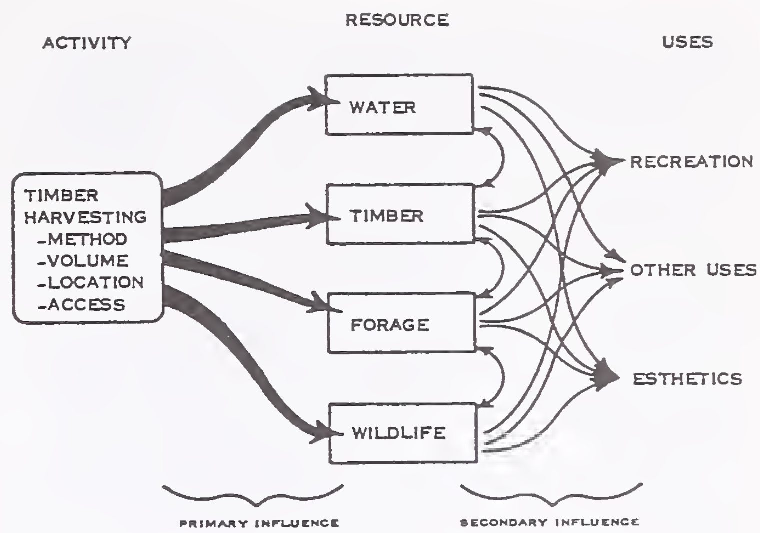

Figure 1.--The influence of timber harvesting activity on resources and uses

Environmental Policy Act in 1968. This Act directs the land manager to assess his management activities from an environmental impact standpoint. The Act declared it "a national policy [to] encourage productive and enjoyable harmony between man and his environment; [and] to promote efforts which will prevent or eliminate damage to the environment" (USDA Forest Service 1974:243). "This policy is one of balancing the amenities or quality of life against the continued use of renewable resources" (Leopold 1975:609). By this act the manager must prepare a detailed statement of the environmental impacts of any proposed action that might have an effect on the quality of the human environment. These impacts must include not only the short-term immediate effects, but also the long range effects of the activity.

As an example of man's activities impacting the ecosystem, we might look at the timber harvesting example illustrated in Fig. 1. The harvesting of timber from a given area and the method used in harvesting will have a direct effect on the area's resources: water quality and quantity, timber availability now and in the future, forage quality and quantity, and the amount and type of wildlife present. These can be both short and long range effects.

In addition to these primary effects, the changes in available resources will cause a change in the possible uses of the area. The recreational appeal and aesthetics of the area will be influenced secondarily. There are also secondary influences between resources, that is, a change in water quality

might affect fish populations. A change in the timber or vegetation will cause a change in the water quality and quantity. It can also cause a change in the wildlife of the area.

Fire is a natural force which will impact the resource system in a similar manner. Fire removes vegetation from the system. This vegetation can be either live or dead. It removes timber from the growing stock; it exposes mineral soil to the ravages of wind and rain, increasing soil erosion. On the other hand , fire also acts as a rejuvenator; it promotes species diversity; it can remove ground cover to accept seed for regeneration; it can promote browse and forage production. Fire is a production factor in the wildland ecosystem. The "goodness" or "badness" of any of these consequences can only be judged relative to the management objectives established for the area.

The ecosystem we are managing is a maze of complex interacting cause-and-effect relationships. This complexity makes multiple use management with the evaluation of environmental consequences difficult to practice in a real-world situation. The resources of an area and the uses of those resources are affected over a considerable time period when a particular impact or activity is imposed on the system. These impacts must be projected and evaluated before an activity is started. Activity strategies must be compared to pick the most desirable strategy in meeting public demands and management objectives.

Modeling and simulation is a tool which can help the manager project consequences into the future. The dynamic responses of the ecosystem can be presented in comparing alternatives over extended time periods. Simulation can help clarify the manager's thinking and can be a valuable tool in his decision making.

SIMULATING FIRE

The land manager must make decisions on which course of action is most desirable in a given situation. Simulation is a valuable tool to help in analyzing the consequences of a proposed strategy. With fire the basic decision facing the manager is one of balancing the trade-offs between fire use and fire control. From a modeling standpoint this might be illustrated as in Fig. 2.[1]

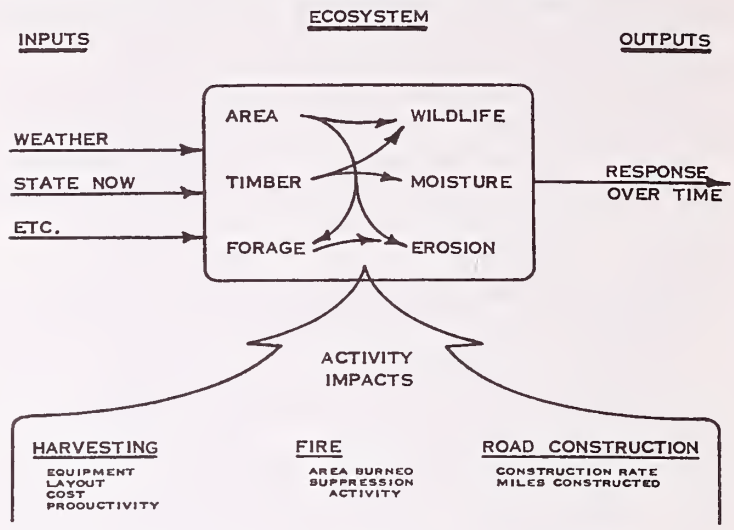

Figure 2.--Black box diagram of ecosystem response to activity impacts

Shown is a diagram of the ecosystem with its inputs and outputs. The inputs to the system include such things as weather and the state or condition of various resources of the area as they exist now. The model is then subjected to some form of external impact; be it timber harvesting, fire under a given strategy, or road construction. The ecosystem model is allowed to respond through its internal interactions to provide the output in the form of resource and environmental response over time.

As mentioned before the decision relative to fire is basically one of balancing the fire use and fire control strategy for a given land area. The information flow for a fire management decision process might be illustrated as in Fig. 3.[2] To build such a system there are basically three components for information processing: fire behavior, fire effects, and economic evaluation. Each

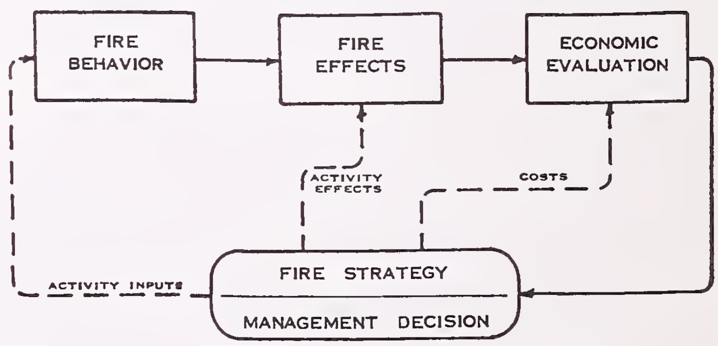

Figure 3.--Information flow for fire management decision system.

1/Egging, L. T. 1977a. Systems and simulation in natural resource planning. Manuscript in preparation.

2/Egging, L. T. 1977b. Integrating fire into land management planning: A perspective. Manuscript in preparation.

of these may be thought of as a model to represent some phase of the real situation.

Much work had been done to improve fire behavior modeling. The National Fire Danger Rating system attests to this fact (Deeming et al. 1974). The work by Rothermel (1972) has contributed to the increased capability in modeling fire spread in wildland fuels and the work of Albini (1976) in estimating wildfire behavior. However, this work is only a beginning in the development of fire management decision system. The outputs from this behavior modeling effort must be coupled with fire effects models. This effort might be diagramed as in Fig. 4.

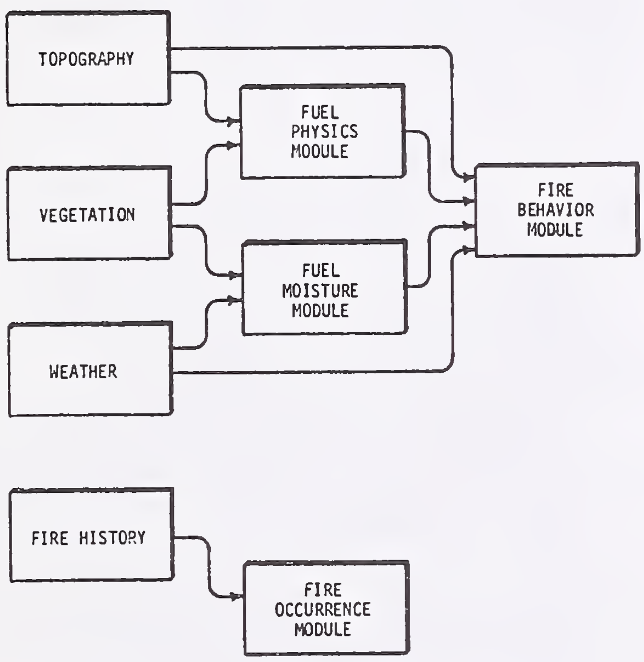

Figure 4.--Fire behavior system.

First, we must be able to describe the on-the-ground situation in terms required for modeling fire behavior. This description includes such things as topography, vegetation, fuel inventory, and weather. This information, in turn, is utilized to describe the fuels situation from both a physical standpoint and its moisture characteristics. All of this information is utilized by the fire behavior model to predict such fire attributes as rate of spread, intensity, and duration.

This leads us to the next phase of our fire management decision system. Namely, the fire effects models. We must now convert the fire behavior information into terms meaningful for evaluating the ecosystem response with respect to the management objectives. This can be done by simulating the response of resources over time to fire effects. The components of this modeling effort can be broken down as shown in Fig. 5. For example, we may look at the primary effects of fire on soils, vegetation, and air quality. Air quality is something that becomes more and more important when we start looking at prescribed burning strategies over large areas. It is one important factor that should be included in any fire effects modeling effort. Following these primary effects of fire we can now start looking at the ecosystem response to the fire impact. This response can be expressed in terms of changes in resources or resource production over extended time periods. It also includes the environmental consequences of the fire impact over time.

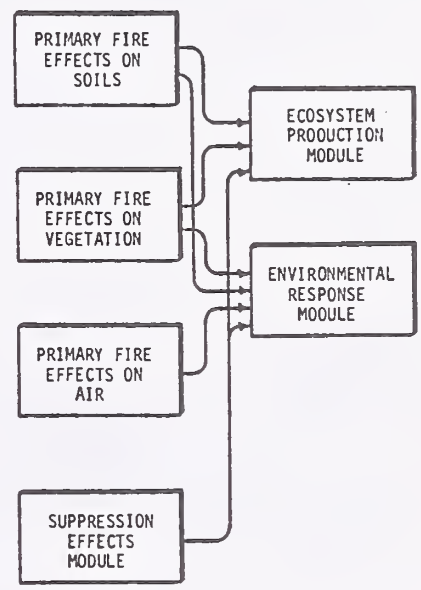

Figure 5.--Fire effects system.

These consequences can be simulated to give projections of resources such as illustrated in Fig. 6 (Egging 1977a). Such an illustration shows the interactions between resources. The environmental consequences of the impact and subsequent management activity can also be represented.

This information is then utilized as a basis for making an economic evaluation of the strategy under consideration. The economic evaluation model can be diagramed as in Fig. 7. It consists of three basic components. The first is an evaluation of changes in resource production. The second is an evaluation of the environmental consequences, such as air quality, and erosion. Finally, the consequences of the strategy in terms of production and environmental factors are evaluated as to how well they meet the performance criteria established in the management objective.

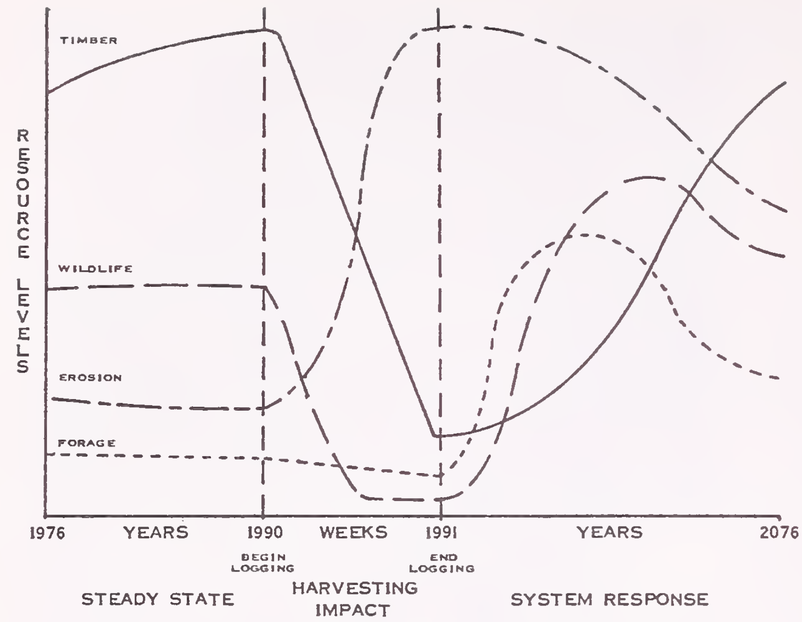

Figure 6.--Hypothetical example of ecosystem response to impact.

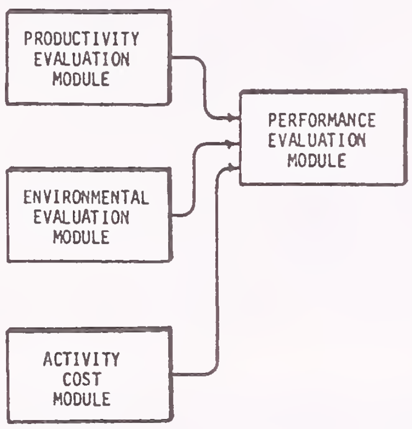

Figure 7.--Economic evaluation system.

Multi-resource simulation models can provide the resource manager with a powerful thinking tool for evaluating the consequences of the alternate management practices he has at his disposal. However, such management-oriented models must prove to be more useful than the judgment based on the manager's own experience before they will be used.

To be actively employed by managers, simulation models must have user-dedication. To accomplish this, the model must be designed by managers with respect to the kinds of questions to which he is seeking answers, the effects of specific management practices over which he has control, the form of the output of the model in terms of tables and graphs, and the units of the output the manager is used to working in. In addition, the input needed to operate the model must be that which is available to the manager.

Of the hundreds of models built for managers, few receive dedicated use because the managers were not involved in the building of the model. We believe that models can serve as useful thinking tools for managers if managers actively participate in the beginning stages of modeling and throughout the model development. User-dedication of models will come only through user-involvement in their construction.

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FIRE WORKING GROUP

CURRENT TRENDS IN LEGISLATION AFFECTING FOREST PRACTICES RELATED TO FIRE: SESSION SUMMARY.

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"The first step in forest management is protection from fire" is the axiom we've worked with for the past sixty-five years. The Weeks Act of 1911 started us in the right direction and was followed by the Clarke-McNary law (CM-2) in 1924. The results have been spectacular in that as late as 1940, 30 million acres were being burned annually. These losses have been reduced to 10% of that figure.

In talking about legislation we should also talk about funding. The Clarke-McNary law allows the federal government to contribute up to 50% of the total cost of fire protection experienced in the states. Until 1978, the high point had been reached in 1974 when 25 million dollars had been granted. For several years after 1974 the administration demanded elimination of all funding for CM-2. The funding levels granted by Congress for the period 1975-77 were $22.6 million, $20.6 million and $18.6 million, respectively. A combination of changing attitudes in the Congress combined with the implementation of the RPA Act has seen a dramatic rise in the federal funding share to $30 million in 1978. With these funds, fire management, as we consider it today, can become a reality. Whereas for the past 4 or 5 years fire organizations have been experiencing retrenchment, the funds should now become available to implement the fire management tool.

Other laws have had an impact on the evolution of fire management. The Wilderness Act of 1964 has been interpreted by many as the device which introduced the "let burn" policy. It should be remembered, however, that fire control is not excluded by the Wilderness Act. It does allow, however, for a conscious decision to allow a fire to burn if the benefits exceed costs.

The National Environmental Policy Act of 1969 (NEPA) provided the mechanism for determining environmental impacts, and involvement of the public in decision making often resulting in challenges regarding fire exclusion. The filing of environmental impact statements has led to modeling systems for decision making.

The Clean Air Acts, while admirable, are leading to conflicts between state air pollution authorities and others, particularly forestry agencies. For example in the State of Montana the air pollution authority is endeavoring to eliminate slash burning and the burning of irrigation ditches. It is also anticipated that home fireplaces will be regulated. This is as it should be since visible air pollution from this source can be dramatic in areas affected by inversion layers. Oftentimes, in such instances, breathing can become difficult.

In the Willamette Valley of Oregon, grass growers are being limited to a ceratin number of acres burned annually; these acreage allotments are being reduced. Farmers are being told to find other ways to substitute for fire. Smoke is so serious, the Southern Fire Laboratory at Macon, Georgia is devoting almost full time to smoke management research. In the south, managed fire is a key tool in forest management. It must not be lost.

The Forest and Range Land Renewable Natural Resources Planning Act of 1974 (RPA) is forcing "people" to question current policies and procedures of fire control organizations; for example: the 10 AM control policy.

Finally, the National Forest Management Act of 1976 will lead to decisions on the use of fire in fuel treatment, timber stand improvement and slash disposal. Just how this Act will affect fire management remains to be seen.

Turning to the states, some of the relevant legislation can be broadly categorized into two groups. The first one is the state forestry enabling legislation within each state and the related wildland fire protection authorities and laws that individual state legislatures have provided to deal with their local problems. Not one state is lacking in some sort of legislation regarding wildland fire and fire protection; this couldn't be said 15 or 20 years ago. More recently, mostly in the decade of the seventies, several state legislatures passed legislation in land use planning which directly or indirectly affected land management, fire planning and the fire protection job of state and local governments. Examples of this are the California legislation of 1971 with regards to zoning and subdivisions in new road building practices and Colorado's Senate Bill 35 which requires the State Forester to review all new subdivisions and House Bill 1041 requiring the State Forest Service to fire hazard map the forest and wild lands of the State. Some of the state laws are heavily directed toward state forestry organizations and some are directed toward counties and municipalities. Like the basic state forestry legislation, it is going to take a long time before the majority of the states have desirable laws or practices, integrating land use planning and fire management programs.

A question often asked is, "What does the public seem to want?" Is there any one particular public? There are many publics wanting many different things with regard to forest land management, fire and fire management. Many of those publics conflict in their wants and desires. Some of the staunchest "preservationist" groups are opposed in their views of wanting fire to either be controlled or not in wilderness areas. What does the public seem to want? We should try to find out what the various publics want. Then the job becomes one of integrating those various wants into programs that are acceptable to most publics, hopefully all.

Where are we headed professionally? We are climbing onto higher and higher levels of thinking and plateaus. No longer are we acting blindly on imposed, often self-imposed policies. More and more foresters and fire fighters are questioning policies. They're looking at the environment versus the impacts of fire on a site and are questioning the need for certain kinds of management and fire control techniques. The past 6 to 7 years in our nation's history have seen greater integration of fire into the total land management package. Fire is one of the driving forces at our disposal in manipulating and managing forest cover for whatever benefit we desire. From the legal standpoint, it is questionable whether or not we as a profession can meet the various deadlines legally imposed upon us and still do a quality job. Good land management and good fire management must be predicated on a well-financed, well-equipped, well-trained fire suppression force to keep fire out of the woods when it is not needed. That's basic, and we should not lose sight of that particular foundation block that has taken 50, 60 or 70 years to establish.

What are the weaknesses in the current systems? Policies need to be thoroughly reviewed and clarified. An example again is the 10 AM fire control policy. Then, too, certain agencies should review their policies requiring every fire to have a fire line built around it. Some Alaska lands don't tolerate that kind of thing and a cold trail black line is certainly more environmentally sound than the bulldozer line. Many of our fire control and fire suppression policies in the past have been simple, easy solutions and as such have not always been correct. Each needs to be thoroughly investigated and re-evaluated in the next 3 to 5 years. Further, conflicting legislation needs resolution. Slash disposal laws and pollution standards are at odds.

Where should we be going? It seems reasonable to suggest we try to avoid additional federal laws; modification of some of the present laws may be in order. State legislation is something else. It seems perfectly reasonable to suggest that the Society of American Foresters develop model laws for implementation by the states.

There is a need to address the liability problem locally. It's no secret that an unwanted fire on adjacent forest land owners leaves the burning authority open to litigation.

We as foresters need to communicate fire research needs better. A recent regional conference on research needs listed the research needs in priority order for forest and range lands. Fire related research was far down the list of needs.

This fire working group should take command and lead the way in fulfilling the various needs outlined in this paper. Chapters and Sections could be the instigators of state laws, state and county regulations. Earlier in this fire working group meeting, we discussed definitions for fire management, wildfire and prescribed fire. You came to no conclusion except the possibility that some other groups of foresters or fire fighters would solve these problems of definition. It is your job, working through the SAF, to make these decisions. If you don't perhaps the U.S. Department of Commerce will!

SUMMARY OF THE SESSION

In combination, the papers presented this afternoon comprise a basic course in fire management. The session started with definitions of terms, a discussion of the needs, problems and the benefits of using fire as a management tool. In two short hours, we moved from this to modeling and simulation.

Dr. Rupert Cutler commented on many of the basics in fire management, indicated continued and possible expansion of the federal role in land use planning. Fire will become a credible tool depending upon our ability to cope with public attitudes. In short, fire escapes and higher than planned heat intensities must be kept to a minimum.

Bill Lyon quoted an excellent definition of land use planning as follows, "Planning is essentially the allocation and balancing of resource potentials with resource demands within social, political, biological, physical, economic and legislative constraints." He outlined for us a planning system in following the basic relationships, emphasizing public participation. Planning philosophies were discussed in such areas as long term -short term, on site - off site, and so forth. Also shown and discussed were the probabilities, impacts and effects which the planner must know to assure consideration of the philosophies.

Clint Phillips gave the audience the four prerequisites to be considered before development of a plan for fire management: (1) Establish objectives for managing resources; (2) Effects of fire and fire management upon resources; (3) Effects of resource management on fire management; (4) Suggested procedure for developing a plan of fire management.

He introduced us to a model for integrating fire management into resource management considering the various objectives, assessments, criteria, alternatives, comparisons and plans. He concluded with a key philosophical comment which states, "The fact is well established that fire has played some role in virtually every ecosystem we manage today. It is important and logical that the role of fire be recognized in the process of preparing alternatives for managing resources."

Freeman Smith and Louis Egging introduced many of us to the use of simulation in the modeling process. They pointed out the needs which include the difficulty to quantitatively evaluate the effects of fire on wildlife habitat structure, forage production, water yield, erosion and recreation. Further, in the past, judging the effects of fire has been done through experience. Collectively, 80% to 90% of the answers to questions regarding fire management are known. Synthesizing these answers is a basic need. As a solution our familiarity with the taxonomic key of tree species was identified as a static system. On this basis of understanding they built an understanding of a systems approach resulting in a computer program, a dynamic model.

To many of us "simulation" and "modeling" can be classified as "mumbo-jumbo". Fortunately, an illustration was used which bears repeating here.

> A model airplane is a common example used to illustrate the difference between static and dynamic models. If the purpose of modeling an airplane is to display a miniature on a desk, the model is static. If the purpose is to build a model to fly by remote control, we must include an engine and mechanisms to accomplish maneuvers, i.e. flaps, elevators, rudders and a remote control radio.

To those people in the modeling business this illustration is common. For those of us outside the discipline, it is the kind of device we need to more fully understand the concept.

Over the years many foresters and other land managers have realized that dynamic models for timber harvest and volumes are available and of value in managing resources. Smith and Egging pointed out how this model can be expanded to include fire management.

In conclusion, fire management offers one of the most efficient, economical tools in developing and maintaining healthy, viable, productive forests. Utilization of the information presented at this meeting should help in implementation of fire management and an understanding of the principles by not only fellow foresters and land managers but the public as a whole.

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A compilation of papers presented at the Society of American Foresters, Fire Working Group Technical Session, Albuquerque, N. Mex., Oct. 2-6, 1977. Keynote address by Dr. M. Rupert Cutler, Assistant Secretary of Agriculture, dealt with the session's theme, the relationship of fire to land management. Subsequent papers discussed fire information required by land managers, how fire-related activities can be adapted to land management, using simulation as a planning tool, and legislation affecting use of fire in forestry practices.

KEYWORDS: fire, fire management, land management, planning.

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A compilation of papers presented at the Society of American Foresters, Fire Working Group Technical Session, Albuquerque, N. Mex., Oct. 2-6, 1977. Keynote address by Dr. M. Rupert Cutler, Assistant Secretary of Agriculture, dealt with the session's theme, the relationship of fire to land management. Subsequent papers discussed fire information required by land managers, how fire-related activities can be adapted to land management, using simulation as a planning tool, and legislation affecting use of fire in forestry practices.

KEYWORDS: fire, fire management, land management, planning.

Headquarters for the Intermountain Forest and Range Experiment Station are in Ogden, Utah. Field programs and research work units are maintained in:

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